FigShare Dataset Name: **Dataset: Climate-induced shifts in sulfate dynamics regulate anaerobic methane oxidation in a coastal wetland**

Citation: Jaehyun Lee, Yerang Yang, Hojeong Kang, Genevieve L. Noyce, J. Patrick Megonigal. Climate-induced shifts in sulfate dynamics regulate anaerobic methane oxidation in a coastal wetland. *Science Advances (in revision).*

The dataset is composed of 6 files providing the data used in the paper Lee et al.:

1. **Read Me (2024-11-20).pdf**: This document explains the contents of the dataset.
2. **SMARTX redox potential in C3 community (20 cm)\_May-July 2022.csv**: This file contains monthly average redox data for ambient, +5.1 °C, *e*CO2, and +5.1 °C + *e*CO2 plots in May-July 2022.
3. **SMARTX fine roots in C3 community\_2022.csv**: This file contains fine root biomass for ambient, +5.1 °C, *e*CO2, and +5.1 °C + *e*CO2 plots in 2022.
4. **SMARTX CH4 fluxes\_June 2022.csv**: This file contains CH4 fluxes for ambient, +5.1 °C, *e*CO2, and +5.1 °C + *e*CO2 plots in June 2022.
5. **SMARTX porewater sulfate & chloride\_May and July 2022.csv**: This file contains porewater SO42– and Cl– concentration data for ambient, +5.1 °C, *e*CO2, and +5.1 °C + *e*CO2 plots in May and July 2022.
6. **SMARTX ANME abundances\_June 2022.csv**: This file contains the abundances of ANME-1 and ANME-2c for ambient, +5.1 °C, *e*CO2, and +5.1 °C + *e*CO2 plots in June 2022.
7. **SMARTX S-DAMO rate\_June 2022.csv**: This file contains the sulfate-dependent anaerobic methane oxidation rates for ambient, +5.1 °C, *e*CO2, and +5.1 °C + *e*CO2 plots in June 2022.

This Read Me file has two details that describe the dataset (Table 1) and the variables in the data files (Table 2).

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| **Table 1. Description of the dataset.** | |
| 1. Name | Jaehyun Lee |
| 2. Dataset File Name | Dataset: Climate-induced shifts in sulfate dynamics regulate anaerobic methane oxidation in a coastal wetland |
| 3. Dataset Version | Version 1 |
| 4. Lead Investigators | Jaehyun Lee, J. Patrick Megonigal |
| 5. Other Investigators | Genevieve L. Noyce, Yerang Yang, Hojeong Kang |
| 6. Contact | Jaehyun Lee, jaehyunlee@kist.re.kr, +82-10-4256-0713  Pat Megonigal, megonigalp@si.edu, 443-482-2346 |
| 7. Start Date | 2022 |
| 8. End Date | 2022 |
| 9. Location | 38°55’ N, 76°33’ W; Smithsonian Global Change Research Wetland, Smithsonian Environmental Research Center, Edgewater, MD 21037. |
| 10. Taxa | NA |
| 11. Keywords | warming, elevated CO2, global change, anaerobic methane oxidation, sulfate dynamics |
| 12. Abstract | Anaerobic methane oxidation (AMO) is a key microbial pathway that mitigates methane (CH4) emissions in coastal wetlands. However, the response of AMO to rapidly changing global climate remains poorly understood. Here, we assessed the response of AMO to climate change in a brackish coastal wetland using a five-year field manipulation of warming and elevated CO2 (*e*CO2). Sulfate-dependent AMO (S-DAMO) was the predominant AMO process at our study site due to regular tidal inputs of sulfate (SO42–). However, SO42– dynamics responded differently to the treatments; warming reduced SO42– concentration by enhancing SO42– reduction, while *e*CO2 increased SO42– concentration by enhancing SO42– regeneration. S-DAMO rates mirrored these trends, with warming decreasing S-DAMO rates and *e*CO2 stimulating them. These findings underscore the potential of climate change to alter soil AMO activities through changing SO42– dynamics, highlighting the need to incorporate these processes in predictive models for more accurate representations of coastal wetland CH4 dynamics. |
| 13. Related Materials | None |
| 14. Related Links | <https://serc.si.edu/gcrew/warming> |
| 15. Related Datasets | None |
| 16. Research Topic | Methane cycle response to elevated CO2 and warming. |
| 17. Study Type | Biogeochemistry. |

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| **Table 2. Description of variables in the data files.** | | | | |
| **File Name** | **Variable Name** | **Variable Description** | **Units** | **Codes** |
| SMARTX redox potential in C3 community (20 cm)\_May-July 2022.csv | Year | year of data collection | none | none |
| Month | month of data collection | none | none |
| Plot | 3-digit plot ID | none | none |
| Temperature Treatment | target temperature differential for whole-ecosystem warming | °C | 0 = Ambient; 5.1 = +5.1 °C above ambient |
| CO2 Treatment | ambient or elevated CO2 treatment | none | Amb = ambient; Elev = elevated |
| |  | | --- | | Monthly Average  Redox Potential (mV) | |  | | mean monthly soil redox potential at a 20 cm depth | mV | none |
| SMARTX fine roots in C3 community\_2022.csv | Year | year of data collection | none | none |
| Plot | 3-digit plot ID | none | none |
| Temperature Treatment | target temperature differential for whole-ecosystem warming | °C | 0 = Ambient; 5.1 = +5.1 °C above ambient |
| CO2 Treatment | ambient or elevated CO2 treatment | none | Amb = ambient; Elev = elevated |
| |  | | --- | | Root productivity (g/m2/year) | |  | | fine-root productivity from Nov. 2021 to Nov. 2022 | g m–2  year–1 | none |
| SMARTX CH4 fluxes\_June 2022.csv | Year | year of data collection | none | none |
| Day of Year | Julian day of data collection | none | none |
| Plot | 3-digit plot ID | none | none |
| Vegetation | vegetation community | none | C3 = C3-dominated vegetation community  C4 = C4-dominated vegetation community |
| Temperature Treatment | target temperature differential for whole-ecosystem warming | °C | 0 = Ambient; 5.1 = +5.1 °C above ambient |
| CO2 Treatment | ambient or elevated CO2 treatment | none | Amb = ambient; Elev = elevated |
| CH4 flux (umol CH4/m2/day) | methane flux measured using static chambers | µmol CH4 m–2 day-1 | none |
| SMARTX porewater sulfate & Chloride\_May and July 2022.csv | Year | year of data collection | none | none |
| Month | month of data collection | none | none |
| Plot | 3-digit plot ID | none | none |
| Vegetation | vegetation community | none | C3 = C3-dominated vegetation community  C4 = C4-dominated vegetation community |
| Temperature Treatment | target temperature differential for whole-ecosystem warming | °C | 0 = Ambient; 5.1 = +5.1 °C above ambient |
| CO2 Treatment | ambient or elevated CO2 treatment | none | Amb = ambient; Elev = elevated |
| Depth | depth of porewater chemistry measurement | cm | none |
| |  | | --- | | SO4 (mM) | | concentration of SO42– in porewater sample | mM | none |
| |  | | --- | | Cl (mM) | |  | | concentration of Cl– in porewater sample | mM | none |
| SMARTX ANME abundances\_June 2022.csv | Year | year of data collection | none | none |
| Month | month of data collection | none | none |
| Plot | 3-digit plot ID | none | none |
| Vegetation | vegetation community | none | C3 = C3-dominated vegetation community  C4 = C4-dominated vegetation community |
| Temperature Treatment | target temperature differential for whole-ecosystem warming | °C | 0 = Ambient; 5.1 = +5.1 °C above ambient |
| CO2 Treatment | ambient or elevated CO2 treatment | none | Amb = ambient; Elev = elevated |
| |  | | --- | | ANME-1 abundance  (copies/gdw) | | soil ANME-1 abundance | copies gdw–1 | none |
| |  | | --- | | ANME-2c abundance  (copies/gdw) | |  | | soil ANME-2c abundance | copies gdw–1 | none |
| SMARTX S-DAMO rate\_June 2022.csv | Year | year of data collection | none | none |
| Month | month of data collection | none | none |
| Plot | 3-digit plot ID | none | none |
| Vegetation | vegetation community | none | C3 = C3-dominated vegetation community  C4 = C4-dominated vegetation community |
| Temperature Treatment | target temperature differential for whole-ecosystem warming | °C | 0 = Ambient; 5.1 = +5.1 °C above ambient |
| CO2 Treatment | ambient or elevated CO2 treatment | none | Amb = ambient; Elev = elevated |
| |  | | --- | | S-DAMO rate  (nmol CO2/gdw/day) | |  | | sulfate-dependent anaerobic methane oxidation rate | nmol CO2 gdw–1 day–1 | none |